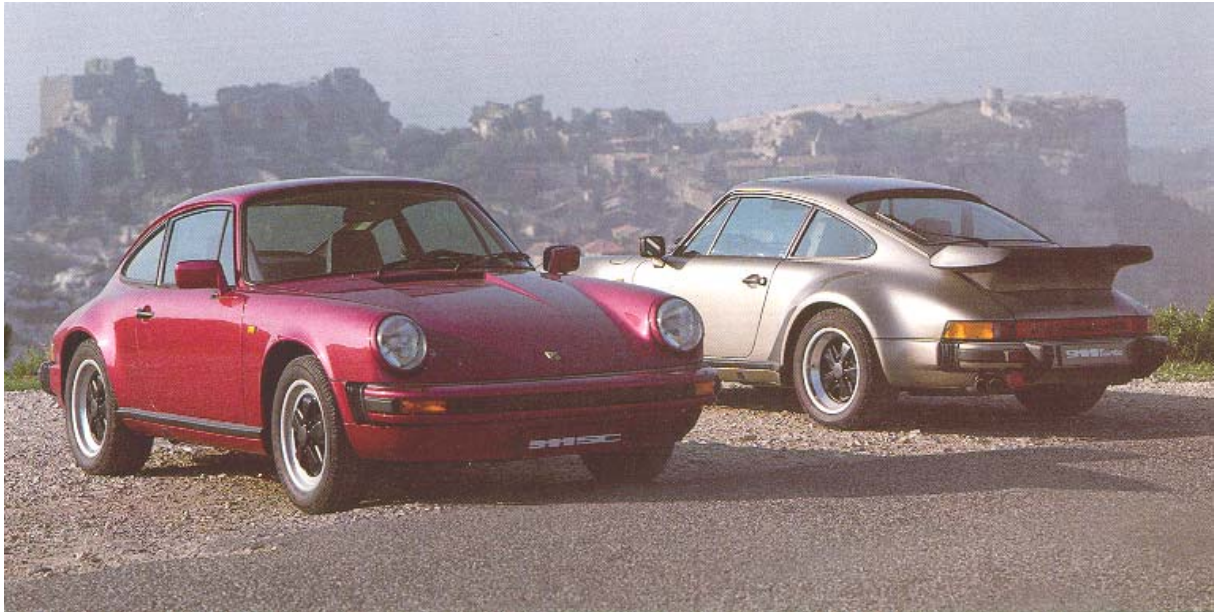


## **Lenz PowerKat® System for Porsche 911 SC 3.0 Bj. 78-83**



### **1. The Porsche 911 SC**

In model year 1978 the different features of the forever-young remaining 911 were summarized: as Super Carrera the 911 SC united past S (super) and high performance C (Carrera) in a new model. From a 3.0 liter capacity, however according to the then current trend designed for regular grade fuel, 180 HP were first available. In the course of the model development the power was increased in model year 1980 to 188 HP and in model year 1981 to 204 HP, with higher compression designed again for super fuel and around 15% more economical in relation to the original version.

In addition to the already longer known targa version there was for the first time with the SC again a cabrio model.

The Porsche 911 SC 3.0 had by far the most reliable and mechanically most developed engine, without considering the susceptibility of the timing chain tensioning mechanism. This weakness was only eliminated with the successor 911 Carrera 3.2 by introduction of hydraulic chain tensioners.

Due to the different emission laws in the export markets, there were no less than six different engine variants of the 911 SC. Exhaust emission control was achieved depending upon pollutant standard using the standard secondary air injection by recycling of exhaust gases or with an exhaust catalyst. The catalyst version with lambda sensor, built for the US market starting in 1980, was offered on the German market but does not fulfill today's emission regulations.

The environmental politically driven forced disadvantage of driving bans for non-catalyst vehicles during ozone alarms, permanent driving bans in ever more city centers, of drastically higher taxation since July 1997 and as well as lower resale chances forces many vehicle owners to the catalyst retrofit. Many Porsche drivers do not want to accept a performance loss from a catalyst retrofit if possible. The newly developed Lenz PowerKat® system offers with most modern technology for the Porsche 911 SC a solution to also connect optimized pollutant levels with again improved performance in the comparison to the base engine.

## 2. The conception of the Lenz PowerKat<sup>®</sup> system

The Lenz PowerKat<sup>®</sup> system is conceived as an uncompromising high end catalyst retrofit system particularly for high performance engines. Developed on the basis of an efficient digital engine management, with components specially matched to the engine and using a metal catalyst, this system achieves optimal pollutant values with clearly improved engine performance. As pollutant standard, the guideline 91/441 (euro 1) is effective at present, with which the retrofit vehicles are absolutely equivalent in comparison to the today's state of the art. By the classification as low-pollution, the Lenz PowerKat<sup>®</sup> retrofitted vehicles are excluded from the driving ban during ozone alarm (ozone plaque) and are taxed according to the Euro 1 - rates presently at 10.40 EURO /100 cm<sup>3</sup>.

## 3. Technical implementation

Principle item of the Lenz PowerKat<sup>®</sup> system is the Lenz KatTronic<sup>®</sup> digital engine management with which injection and ignition can be controlled extremely precisely. Control of the injection amount necessary for lambda regulation is done by an electrical pulse valve in the fuel pressure line to the fuel control valve of the K-Jetronic. The pulse valve permits the change of the turn slot cross sections and thus a variation in the quantity throughput of the continuously working injector over influence of the actuating pressure. The control of the pulse valve takes place directly via the engine management, that as a function of the signal of the lambda sensors, the load, the rpms and the operating condition of the engine computes the optimal injection amount over the injection correction map / data tables. Over sensor technology measured values for temperatures and pressure are processed. The ignition system of the Lenz KatTronic<sup>®</sup> . operates likewise map / data table controlled, the optimal ignition degree is computed as a function of rpms, load, intake manifold pressure and operating condition. The ignition is by high voltage distribution (distributor).

The technology of the mix regulation through a pulse valve was selected for the export models by Porsche, however without integration into an engine management system. An electronic engine control was only realized with the successor 911

## 4. Performance optimization

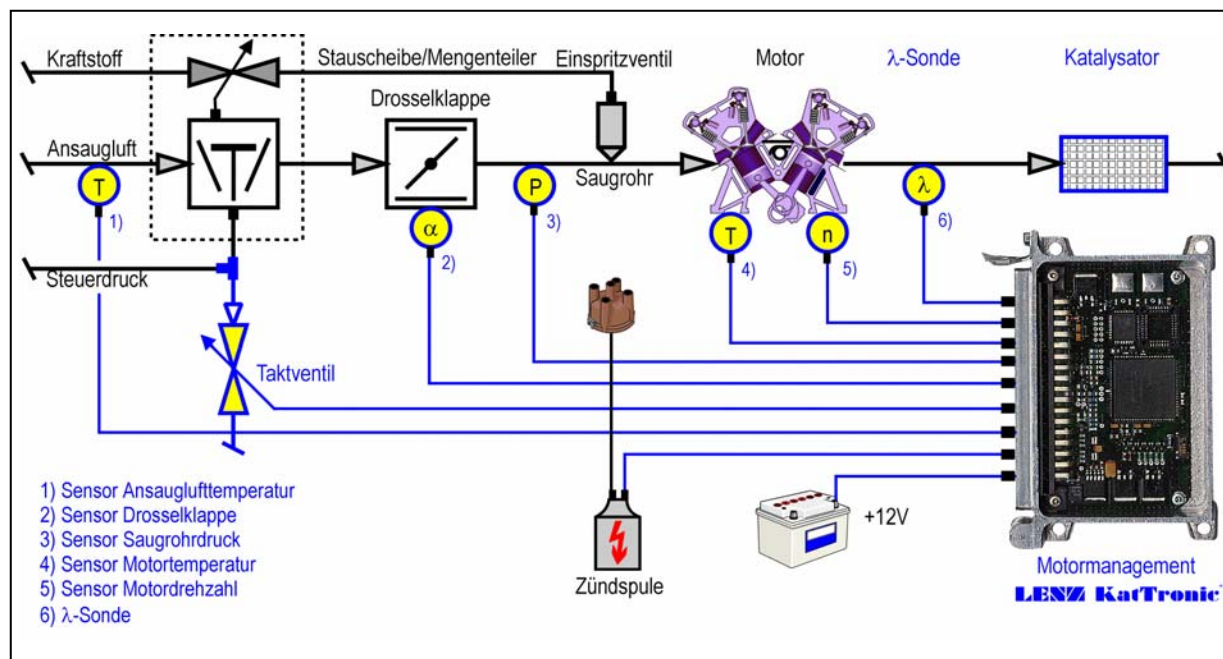
Only through the efficiency of modern engine controls can the constructional potential of a sport engine be effectively used. Basis of the development is a careful analysis of the vibration response of the engine on the intake and the exhaust side. For this, extensive measurements on the Lenz engine dynamometer were performed. Thereupon the basic adjustment of the system components took place in stationary operation. The dynamic behavior of the engine was optimized in numerous measuring runs. From the analysis of data recorded while driving (data-recording) substantial information about improvement potentials in the dynamic behavior could be won, which were transferred to engine control on the software level. Experiences of many years in motor sport flowed into the development, which resulted altogether in a performance-optimized total system.

*For the 911 SC the system was in particular optimized regarding engine performance and accelerating power in the comparison to the non-catalyst base engine concerning response mode, so that the typical character of this vehicle remains also with a catalyst.*

## 5. System structure

The engine-specific adaptation of the Lenz PowerKat system<sup>®</sup> to the injection system is effected through specially developed and adapted sensor/actuator components. For the precise measurement of the operating dimensions of the engine, high-quality, select sensors are used.

**Adaption Lenz PowerKat® an Porsche 911 SC**



**6. The engine management Lenz KatTronic®**

The **Lenz KatTronic® TM** is a modern, modular structured digital engine management for injection and ignition with the Infineon Microcontroller C517A as CPU. The storage of the data tables / maps and control parameters takes place in flash memories. A special, hardware-supported signal processing enables the ultra fast and highly exact processing of the sensor data and a high system throughput. The system software operates real-time, i.e. calculates each injection and ignition phase up to the maximum permissible engine speed in real time from the sensor data and operating dimensions. The result is a delay-free adjustment of the engine control to the respective operating condition.

Special algorithms are implemented in the software management for the optimization of the dynamic behavior. The lambda regulation operates according to a modified PID rule algorithm practically delay-free over the entire load/rpm spectrum, the reference is derived from a lambda data table / map with additional specific corrections. The regulation operates adaptively, i.e. from the measured values of the lambda sensors parameters are derived, which are stored in an adaptation data table / map. In long-term operation performance data are maintained by up-dating of engine electronics on a constant level. On board diagnostic routines permanently monitor the function of the sensor technology and store abnormal operating conditions as well as implausible sensor data for diagnostic purposes. A fail-safe program permits driving in the event of an error. A temperature-dependent speed limiter protects the engine during the warming-up phase against excessive wear by too high rpms.

The development line of the Lenz KatTronic® is based on the Lenz TurboTronic®, a complex, professional engine management system, which was used among other things successfully in formula 1 (BMW engine). From it the Lenz TurboTronicLight® (TTL) is derived, which was conceived as the more economical version of the Lenz TurboTronic® for a broader application in motor sport (DTM) and for the production series applications. The Lenz KatTronic® is a current advancement of the TTL toward pollutant optimization for the application in production vehicles with catalyst.

TurboTronic®, TurboTronicLight® and KatTronic® are developments of Lenz Motorentechnik and as trademarks are legally protected.

**The Lenz KatTronic<sup>®</sup> Engine Management System**



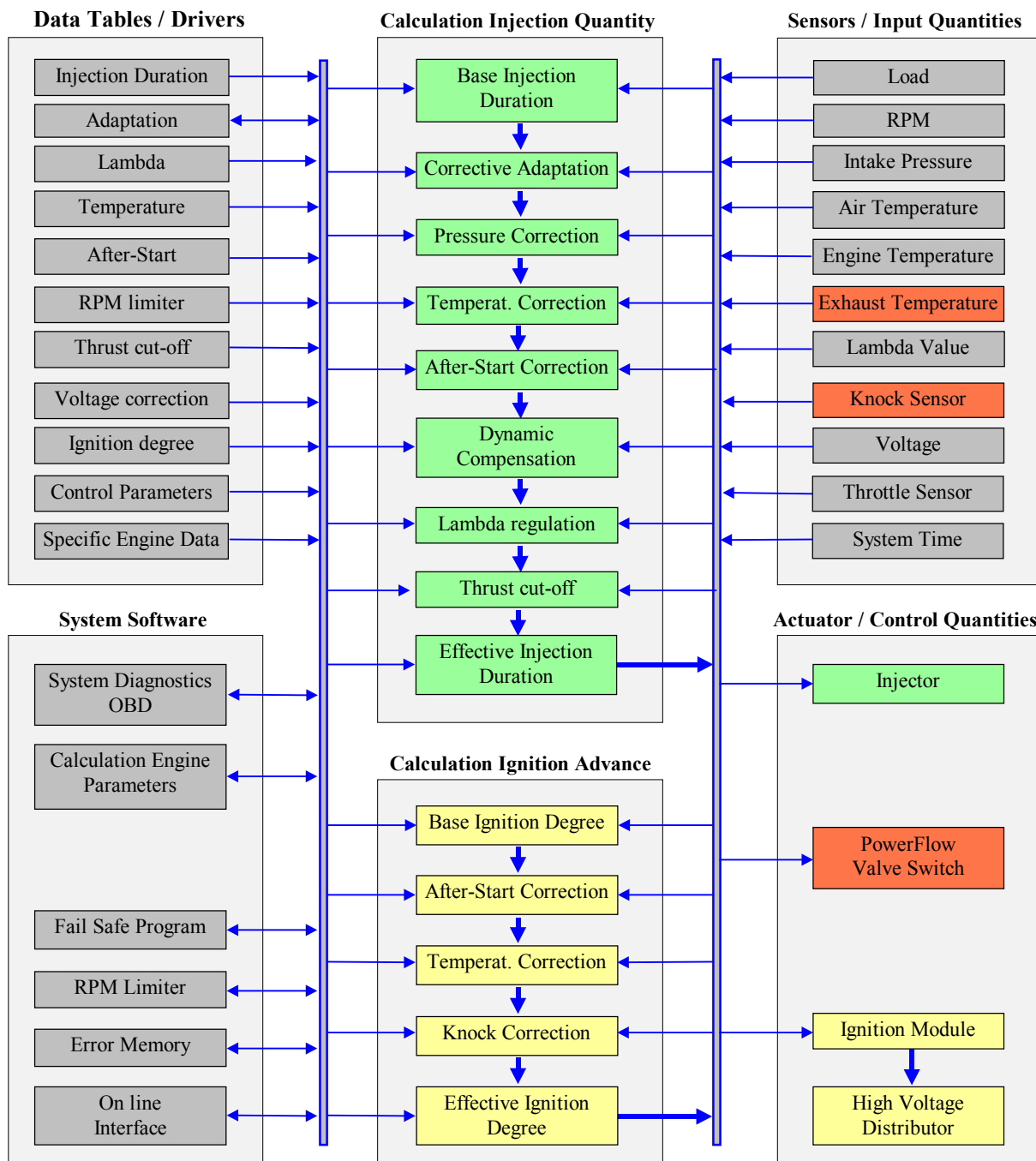
**PICTURE OF CONTROLLER**

The engine management is built into the original ignition housing. The structure is executed in modern SMD technique according to EMV guidelines.

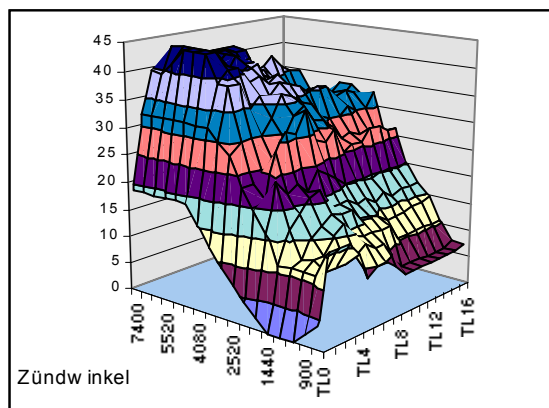
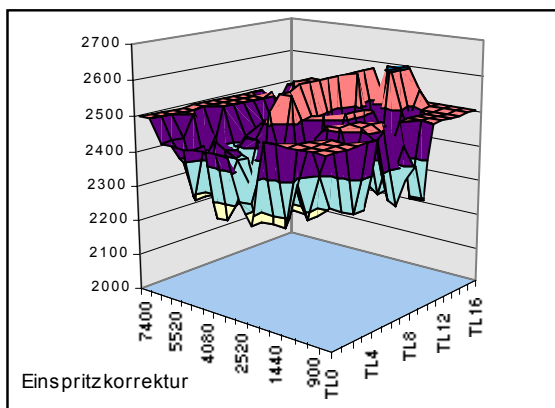
**Overview of the Lenz KatTronic engine management**

<b>Input Values</b>	<b>Output Values</b>	<b>Data Tables / Maps</b>	<b>Data Table Drivers</b>
Intake Manifold Pressure	Idle	Injection	Lambda Sensor
Engine Temperature	Injection	Lambda Value	Engine Temperature
Air Temperature	Ignition	Ignition degree	Air Temperature
Lambda Sensors	Fuel Pump	Lambda regulation	Warm Up
Exhaust Gas Temperature	Boost Regulation	Adaptation	Start Quantity
Throttle Butterfly position		Boost Pressure	After-Start Factor
Rpm Sensor		Load Evaluation	Voltage Correction
Knock Sensor			
<b>Base Functions</b>		<b>Monitoring Functions</b>	
Warm Up		fail-safe Program	
Idle Regulation		Sensor Monitoring	
Temperature Dependent Thrust reduction		Operating Hour Counter	
Temperature Compensation		Temperature Dependent Speed Limiter	
Dynamic Transition Compensation		Error Memory	
Boost Control		Extreme Value Memory	
Asymmetrical PID Lambda Regulation		Serial Interface (RS-232)	

**Functional Structure of the Lenz Katronic<sup>®</sup> Engine Management System**



**Data tables / Maps for injection duration and ignition degree**



**7. The software to the Lenz KatTronic®**

A singular feature of the Lenz KatTronic® is the integrated serial interface to standard PC (operating system MSDOS) executable software. In the standard version important system data can be displayed on-line in current driving conditions on a graphic display (e.g. laptop with MSDOS) and diagnostic data for service purposes can be read-out. For the professional application an extended version is available. This contains functions for system calibration as well as the on-line editing of the data tables / maps and system parameters, with which an individual fine tuning is possible on the respective engine. Further measuring data can be recorded (data recording). In the extended version all functions can be used also over radio data transmission (cell phone with GSM Card) from a stationary PC (telemetry).

Future pollutant standards as well as performance improvements in the course of continuing development can be realized as updates to the operational software problem-free. Therefore the Lenz KatTronic® is a future-safe investment.

**View of Measurement Data Display**

MS-DOS - TTL41		Speichern		Messdaten		Drucken	
<b>Motordaten</b>				<b>Zündungsdaten — P911_SC.ZKF</b>			
Drehzahl	4200 U/min	Kennfeld-Zündwinkel	31.5 °				
Drosselklappe	40 %	Motortemp.-Korrektur	-1.0 °				
Saugrohrdruck	650 hPa	Lufttemp.-Korrektur	0.0 °				
TL / n - Stützstelle	10.1 / 4080	Zündwinkel (eff.)	30.5 °				
Batteriespannung	11.50 V	<b>Einspritzdaten — P911_SC.EKF</b>					
Ladezeit Z-Spule	2.1 ms	Kennfeld-Einspritzkorrektur	6.500				
Spannungskorrektur EV	1.300 ms	Motortemperatur-Korrektur	1.03				
Motortemperatur	82 °C	Lufttemperatur-Korrektur	1.00				
Lufttemperatur	21 °C	BA-Korrektur	1.00				
		Lambda-Korrektur	+480				
		Einspritzdauer (eff.)	7.175				
Sensorstatus ok		Lambda 0.8 1.0 1.2 1.03					
Zahnfehler 0							

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## 8. System components

The Lenz PowerKat® system for the Porsche 911 SC in the base version consists of the following components:

- Wiring harness
- Electric pulse valve
- Pressure and temperature sensors
- **Lenz KatTronic®** engine management
- Metal catalyst with heated lambda sensor

## 9. Results **P – P - C**

### **Performance optimization**

The Lenz PowerKat ® system for the Porsche 911 SC clearly improves the response mode (throttle response), the performance and the accelerating power compared to the base engine, and this, in connection with a catalyst. The torque development is fuller in the entire rpm range, and the response is in particular substantially more pronounced at higher rpms than the series engine.

<b>Torque</b>	<b>Horsepower</b>	<b>Version</b>	<b>Top Speed</b>
<b>267 Nm</b> 5000 rpm	<b>204 PS</b> 5900 rpm	Series engine without catalyst	<b>235 kmh</b>
<b>285 Nm</b> 5000 rpm	<b>220 PS</b> 6200 rpm	<b>Lenz PowerKat®</b> with series exhaust	<b>250 kmh</b>

### **Consumption optimization**

The precise adherence to the ideal values for injection amount and ignition degree and the measurement of the operating condition with high-quality sensors result in a specific consumption particularly favorable in comparison to the series engine. The lambda regulation operates over the entire load and rpm spectrum as a dynamically regulated system of high quality. Thus in mixed driving favorable values consumed are obtained

### **Pollutant optimization**

The Lenz PowerKat ® system for the Porsche 911 SC fulfills the equivalent EC guideline 91/441 and is therefore classified as low-pollution according to Euro-standard I. Thus an engine equipped with the Lenz PowerKat ® system does not fall under a driving ban during ozone alarm, and the ozone plaque can be issued for the vehicle.

## 10. TÜV certification

The Lenz PowerKat ® system was certified by the TÜV Munich for the Porsche 911 SC. In the test report the performance and pollutant values, maximum speed and sound levels were documented. With the available TÜV certification, an entry of the Lenz KatTronic ® into the title / registration papers is possible, problem-free.

## **11. Installation, set-up, maintenance and guarantee**

A substantial advantage of the Lenz PowerKat® system is the lack of mechanical interventions into the engine. The components can be installed by the manufacturer or in authorized workshops problem-free. If necessary, the vehicle at relatively small expenditure can be returned back again to the original state. Under normal conditions the Lenz PowerKat® system is maintenance-free. The special software necessary for the diagnosis and adjustment of the engine control Lenz KatTronic® is available only from the manufacturer or in authorized workshops.

For the installation and initial set-up, the instructions in the installation and operating manual absolutely must be followed. Incorrect assembly of the components can cause malfunctions or damage, in this case the guarantee for the system components expires.

If the vehicle was previously operated with leaded gasoline, then the tank as far as possible must be run dry and before installation, the vehicle absolutely must be driven with a full tank of unleaded fuel in order to exclude damage to the catalyst by lead. Relevant investigations by car manufacturers (Mercedes Benz) regarding lead free operation of engines with not-hardened valve seats conclusively show that as a result of prior long-term actual operating time with leaded gasoline sufficient lead diffuses into the valve seats (memory effect), so that no negative effects are to be expected on the life span of the valve seats. We recommend nevertheless the use of suitable lead replacement additives, which have proven innocuous for emission control systems (e.g. Castrol).

Basic condition for optimal functionality of the Lenz PowerKat® system is naturally a mechanically intact, not worn engine, which was maintained according to the factory specifications. Only in this case can a guarantee for the indicated performance data be made. On the components of the Lenz PowerKat® system, a 1 year warranty starting from delivery date is made.

The price for the system Lenz PowerKat® includes expressly only the components of the catalyst retrofit kit and their assembly. Additionally necessary service work and the exchange of defective or worn components are charged for as incurred. The technical specification refers - if nothing different is mentioned - to the basic version of the Lenz PowerKat - system for the Porsche 911 SC.

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